II.—*On the Advantages possessed by Naval Men, in contributing to General Science.*

There is, probably, no class of society which has more frequent opportunities of adding to the general stock of scientific knowledge, than that composed of persons in the royal and mercantile navy. Their various avocations necessarily carry them to distant regions, many seldom visited; while they not unfrequently have at their disposal various portions of time, which, added together, become considerable, and which might be most beneficially employed in the advancement of general science. It would be the greatest injustice, not to acknowledge the large contributions which have already been made to science, by many naval officers; their well-known works sufficiently attest the importance of their observations and discoveries; but, when we regard the multitude of British ships which traverse the ocean, in every direction, these distinguished individuals only constituted a small fraction of those whose opportunities have been quite as great, if not greater, but who have either altogether neglected them, or have not communicated their observations to the world.

The various sciences which bear immediately on navigation, necessarily claim the seaman's first care, and should constitute those to which he more particularly devotes himself. While, however, his principal attention is devoted to these, he may still, when opportunities offer, materially aid the progress of other sciences, more especially those which may be supposed eventually to contribute to the advancement of navigation. All researches into the composition, temperature, and movements of the sea, come under the latter head; indeed, it may be fairly stated, that a knowledge of the surface currents of the ocean, constitutes an important branch of nautical acquirements. We may, however, inquire how much is really known on this subject, more particularly when we recollect, that the general mass of information, relating to currents, was accumulated before the local attraction of the ship was known to produce the frequently considerable aberration of the needle, which is now ascertained to be the case. It is scarcely too much to say, that every vessel, destined for distant voyages, should be provided with Mr. Barlow's plate, by which the important errors arising from this cause are avoided. There can be little doubt that many minor currents have been stated to exist solely in consequence of inattention to this local attraction; for, if those on board any given ship consider that they are steering one course, while, in point of fact, they are steering another, there is always considerable danger that the difference in the position of the ship, determined by proper observations, and that obtained from dead reckoning, will be set down to current, when no such current may exist. We may also inquire what is known of under-currents. The notices of under-currents are exceedingly rare, and it is still more rare, that any experiments have been made upon them. Capt. Beaufort's experiment of sinking a line in clear water, with shreds of differently coloured bunting at every yard, to ascertain the directions of the under-currents,* seems never to have been repeated.

To quit the subject of currents, which it is not our present object to discuss, we will glance at the state of our knowledge respecting the temperature and saltness of the sea. These subjects have already engaged the attention of many naval men; indeed, nearly all our information on this head is derived from them. First, with regard to the temperature of the sea. The surface temperature will naturally, in a great measure, depend on that of the superincumbent atmosphere; so that, if the latter be variable, we should expect the former to be variable also, while it would remain more uniform in climates less exposed to great vicissitudes. Various causes, however, tend to make the temperature of the sea a much more complicated subject than from this view might be anticipated. Thus, every current, moving from a colder to a warmer region, or from one that is warm to a cold latitude, alters the temperature which any waters may be supposed to possess under any warm climate. The gulf-stream is a case in point; the waters become heated within the tropics, and then flow northwards, over and through waters of an inferior temperature. Hence it has been inferred, and with reason, that great advantages would accrue to navigation, from numerous observations on the temperature of this stream, at different parts of its course.† It would also be advantageous to ascertain at what depths this heated water descends, in various northern parts of the gulf-stream; for, as the waters of this stream are, by being heated, rendered specifically lighter than the cold waters over which they flow, it will probably be found that, towards the northern part of their course they will have much less depth, than to the southward. Experiments to ascertain this fact would require considerable care, particularly as the observer would have to contend with the laws which govern the greatest density of water; consequently, such experiments would be best made in the winter months, when the difference between the surface temperature of the sea, and the temperature of the air, would be most marked. Although we possess many notices of the surface temperature of the ocean, in various latitudes and longitudes, the observations hitherto made are far from being sufficiently numerous for the purpose of obtaining any very important or useful results. The surface temperature of the sea is, therefore, a subject which may readily engage the attention of those who constantly traverse the ocean in various directions, more particularly when the necessary experiments are so easy, merely requiring a little care.*

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* Beaufort's Karamania.

† As a reflow, or counter current, sets down by the Florida Reefs and Kays to the S. W. and W., and consequently brings down colder water from the north, it would be curious to ascertain, in any vessel crossing the two currents, the temperatures of each, where they pass each other, as also the temperature close to the coasts.

The experiments necessary for determining the temperature of the sea, at different depths, can be best made during calms—precisely, therefore, when there is little work to be done on board. It has been found, as might be expected, that, within moderate depths, near the surface, the temperature varies considerably, but that beneath these depths it becomes more uniform. If the ocean were composed of fresh water, we should expect the great depths to be occupied by water of the temperature of between 39° and 40° of Fahrenheit, which, it has been ascertained, is the temperature at which fresh water possesses its greatest density; all water, above or beneath that temperature, rising above it. The case, however, is altered with respect to the water of the sea, which forms a solution of certain salts. We have, therefore, to seek what the greatest density of sea-water may be, or, in other words, the temperature of the sea at great depths, as the heaviest water will necessarily descend to the bottom. As yet, no very satisfactory results have been obtained on this head, but it would appear that the temperature of the heaviest sea-water is certainly not less than that of fresh water, but probably a few degrees below it. It is, therefore, an interesting object of inquiry, and the point can be only satisfactorily determined by numerous experiments. M. Lenz, who accompanied Kotzebue's expedition, inferred, from his various experiments in temperate and warm latitudes, that the decrease of temperature is at first rapid, then gradually decreases, and finally becomes insensible; that the point where the decrease becomes insensible, appears to rise with the latitude. He considered that the latter point is at the depth of from 200 and 300 fathoms between the parallels of 41° and 31° N. while at 21° N. it is near 400 fathoms.

The greatest depth at which the temperature of the ocean has been taken, is 1300 fathoms, in lat. 3° 20′ S. and 7° 39′ E. In this experiment, Captain Wauchope found a temperature of 42° Fahr., the surface-water being at 73°. The same observer obtained a temperature of 51° at 966 fathoms, in lat. 10° N. and long. 25°. W., the surface-water being at 80°. Captain Sabine found in lat. 20° 30′ N. and long. 83° 30′ W., a temperature of 45°½ at 1000 fathoms, the surface-water being at 83°. M. Lenz, obtained 36°½ at 974 fathoms, in lat. 21° 14′ N. and long. 196° 1′ W., the surface-water being at 79°½. The latter experiment gave a lower temperature for deep sea-water than had before been obtained in the tropics, or in the temperate zones; and should these, and some other experiments to the same effect, be confirmed by other observers, it would prove that the greatest density of sea-water is at least below 37° Fahr.*

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* It is exceedingly easy to ascertain the surface temperature of the sea; it merely requires that a bucket of surface-water should be hauled upon deck, at any given hour or hours of the day, and a *good* thermometer be plunged into it, taking care that the thermometer be not exposed to the rays of the sun, or so close to the sides of the bucket, as to take its temperature, which may be different from that of the water. Let these observations be duly entered in a book kept for the purpose, together with another observation, made with the *same* thermometer in the shade, on deck, and immediately *before* it was plunged into the bucket; and at the end of the voyage a valuable series of observations, on the surface temperature of the sea, in certain latitudes and longitudes, and of the temperature of the air at the same time, will have been collected. It may be necessary, perhaps, to caution some of our readers against many of the thermometers sold at the outports, as they are frequently very imperfect instruments.

We are indebted to Capts. Parry, Franklin, Beechey, Scoresby, and Ross, for many experiments at different depths, in cold northern regions; whence we might infer, that the greatest density of sea-water, in those latitudes, was somewhere about 37° or 38°, omitting the observations of Capt. Ross, which would seem to point to a lower temperature for the maximum density. Much would, undoubtedly, depend upon the saltness of the sea at the various situations, but as it is considered that this does not vary very materially on the ocean, generally, we require further experiments, which, when combined with those already made, will enable us the better to form an opinion on this subject.

From the experiments of M. M. D'Urville and Berard, it would appear, that the temperature of the Mediterranean, at great depths, is not by any means so low as that of the Atlantic ocean. The latter found a temperature of 55°½ at the depth of 1200 fathoms, (no bottom,) between the Balearic Isles and the coast of Algiers; three other experiments in deep water gave the same results. From these observations, and others of his own, M. d'Urville considers that all the western part of the Mediterranean, beneath a depth of 200 fathoms, rests uniformly at a temperature of about 55° Fahr.

The saltness of the sea has engaged the attention of several philosophers. Dr. Marcel, who instituted a long series of experiments on this subject, and who was ably assisted by naval men, concluded:

1. That the southern ocean contains more salt than the northern ocean, in the ratio of 1·02919 to 1·02757.

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* The instrument employed by M. Lenz was a large hollow cylinder, closed at both ends by valves which opened upwards. To one of the valves a thermometer was attached, enveloped by a substance which conducted heat with great difficulty, so that it could scarcely lose the temperature which it had acquired below, more particularly being surrounded by a body of water drawn up from thence. The more common method has been to sink a register thermometer, with a metallic case and graduation, (metals speedily acquiring the temperature of the surrounding medium,) and marking the change of temperature which had taken place. Thus, if the index marking the maximum had not been moved forwards, while the minimum index had been driven back, it was considered that the temperature had diminished to the point marked by the latter index. These instruments are far from expensive; but, as it is essential to have them exact, they should always be obtained from well-known makers.

2. That the mean specific gravity of sea-water, near the equator, is 1·02777, intermediate between that of the northern and southern hemispheres.

3. That there is no notable difference in sea-water under different meridians.

4. That there is no satisfactory evidence that the sea, at great depths, is more salt than at the surface.

5. That the sea, in general, contains more salt where it is deepest, and most remote from land; and that its saltness is always diminished in the vicinity of large masses of ice.

6. That small inland seas, though communicating with the ocean, are much less salt than the ocean.

7. That the Mediterranean contains rather larger proportions of salt than the ocean.*

M. Lenz inferred, from his personal observation, made in different parts of the ocean:

1. That the Atlantic Ocean is salter than the South Sea; and that the Indian Ocean, being the transition from the one to the other, is salter towards the Atlantic on the west, than towards the South Sea on the east.

2. In each of these great oceans, there exists a maximum of saltness towards the north, and another towards the south. The first is further from the equator than the second. The minimum between these two points, is a few degrees south of the equator, in the Atlantic, and probably also in the Pacific, though the author's observations did not extend sufficiently low in that ocean.

3. In the Atlantic, the western portion is more salt than the eastern. In the Pacific, the saltness does not appear to alter with the longitude.

4. In going north from the northern maximum of greatest saltness, the specific gravity diminishes constantly as the latitude increases.

The same author considers, that, from the equator to 45° N. the water of the sea, to the depth of 1000 fathoms, possesses the same degree of saltness.

To determine the saltness of the sea with accuracy, cannot be expected from naval men generally, but they can easily aid the investigation, by merely filling well-cleaned bottles with surface-water, taken up in particular latitudes and longitudes, (taking care to cork them immediately,) and if provided with proper instruments, which are far from expensive, with water taken from various depths. Indeed, many an otherwise idle half hour might be well spent in collecting information on the temperature and saltness of the sea; the little trouble it would take being abundantly repaid in the increased interest taken in the voyage, besides the gratification afforded to the observer, in considering that he is contributing to the advancement of general knowledge.

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* According to the same author, 500 grains of sea-water, taken from the middle of the North Atlantic, contained common salt (muriate of soda) 13·3, sulphate of soda 2·33, muriate of lime 0·995, and muriate of magnesia 1·955.

(To be continued.)

III.—*The Cork Pilot.*

After an absence from England of about four years, our ship was ordered home from Gibraltar; and, having made a tolerable passage, we discovered Cape Clear at daylight one morning, late in the month of September. A fine fresh breeze was blowing, before which we were dashing along at the rate of eight or nine knots per hour, when the well-known headland, called Mizen Head, appeared at a distance under our lee. As the day advanced the wind increased, bringing with it thick clouds and drizzling rain, which, as it mingled with the mist of the waves, formed a haze that frequently concealed the land from our view. No one on board was acquainted with the coast, and an anxious look-out was kept for a fishing-boat, from which we might obtain a pilot, as we passed in rapid succession the dark headlands of the Irish coast.

The gale soon obliged us to reduce our sail to close-reefed topsails and foresail; we had looked in vain for a pilot, and it became necessary to lessen our speed, that we might not run to leeward of our port. In this state of anxious uncertainty we remained till near noon, when the clouds broke, the surrounding gloom was speedily dispersed, and we discovered the Old Head of Kinsale about two leagues distant from us. Nor was this all, for we also saw several hookers, as the Cork boats are termed, cruising about on the look-out. The well-known signal for a pilot, the union-jack at the fore, was quickly made, accompanied by a gun, and we had the satisfaction of seeing a whole fleet of these little vessels making all the sail they could to near us.

As we approached each other fast, it was not long before the nearest hooker was alongside of us, and the ship was hove to the wind. This was no sooner done, than our ears were assailed by the welcome sound of a stentorian voice, assisted by a huge speaking-trumpet, calling out, "Is your honour in want of a *nate* lad to carry you in?" Our applicant was quickly answered in the affirmative, and, observing the preparations which were going on for lowering the quarter-boat to fetch him on board, he made signs to keep all fast, telling us, at the same time, to send him the *ind* of a line from our lee main-yard arm. A whip was instantly run out, as he had desired, and a bowline knot made in the end, which was thrown on board the hooker, as she shot up from under our lee-quarter. Paddy having placed the noose over his head,

IV.—*On the Advantages possessed by Naval Men in contributing to General Science.*

(Continued from page 185.)

It may at first sight, perhaps, appear somewhat strange to assert, that naval men can render great service to Geology. Such, nevertheless, is the case; for who have such opportunities of tracing the effects of tides and currents on coasts, the transport of detritus by moving water, the changes in the nature of the bottom in soundings, the geographical distribution of shells, and various other subjects intimately connected with this science. These inquiries are doubtless also highly important to physics, zoology, and other sciences, but they are not the less interesting to the geologist on that account; on the contrary, the greater the perfection of chemistry, physics, zoology, and botany, the greater the progress he will make in his own study.

The depths at which streams of water, produced by tides and currents, are felt, is little understood; neither is the depth at which waves act upon the bottom, by any means ascertained. With respect to the latter it has been supposed, that at 15 fathoms the movement of the bottom, caused by a heavy sea, ceases; this, however, requires confirmation. It is well known, that in eight or ten fathoms the sea becomes turbid and discoloured over a bottom of sand or mud during a heavy gale; but in forming inferences from such facts as these, it will be necessary to guard against the errors that may arise from tides and currents setting from shallow into deeper water.

It has been considered that water, with a velocity of three inches per second, would cut up fine clay; six inches per second, fine sand; eight inches, sand as coarse as linseed; twelve inches, fine gravel; twenty-four inches, pebbles one inch in diameter; while it would require three feet per second to sweep along shivery angular stones of the size of an egg. When the seaman recollects the velocity of some tides over banks, he will, perhaps, be inclined to think, either that there must be very considerable friction, retarding the water at small depths, thus producing a considerable difference between the velocity of the water at the bottom and on the surface, or that the foregoing calculations are incorrect. It is, therefore, a subject which requires that investigation which naval men have greater opportunities of giving it than any other class of persons.

Sea-cliffs afford the best geological sections, particularly on a tidal coast, where the heavy battering power of the breakers acts upon a greater or less perpendicular height, according to the rise or fall of tide. It will be found, that coasts generally are scooped out in proportion to the hardness of the rocks of which they are composed, except when they are flat, and rise out of shallow water, in which case sand is thrown up abundantly by the sea, and being blown by the prevalent winds inland, is accumulated in sand-holes or drones; as for instance, on the coast which stretches from Bordeaux to Bayonne. Naval men, when in harbours, or employed in watering parties on unfrequented coasts, have frequent opportunities of examining sea cliffs, and they can render good service to geology, by making an accurate sketch of such cliffs (in face,) and marking on the sketch the places whence they have detached pieces of rock as specimens. These specimens, when properly numbered to correspond with the sketch, will enable a geologist to determine the superposition of the rocks at those places, if it should have so happened that they rested in beds one above another. Organic remains, or petrifactions of shells, corals, plants, bones of animals, &c., found in beds of rock, being of great importance in geological investigations, the observer should collect as many of them out of those beds which may contain them, as he conveniently can, taking care to injure the fossils (another name for organic remains) as little as can be avoided, and at the same time ticketing the specimens, to correspond with the beds of rock noticed in the sketch.[*]

Specimens of rock are frequently brought home, which have been picked up from sea-beaches; these, from having been rolled about from various situations, possess little value in the eyes of a geologist, as they afford him little positive information respecting the structure of the country visited. Should, however, organic remains be discovered in or among any such rolled beach-pebbles, it would be advisable to bring them away, as they may eventually lead to some useful information.

When, as sometimes happens, a rock which does not lay in beds, and is therefore termed unstratified, comes up to others which do lay in beds or strata, and sends forth veins into the latter, it is advisable to make an accurate sketch of the fact, and to detach pieces of rock, as specimens, as well from the rock or rocks in beds as from that which is unstratified; for probably the different rocks will be found altered in their general characters towards the points of contact. Sometimes a great wall of unstratified rock comes up among other rocks divided into beds, the mass of the latter having not unfrequently fallen down, or slipped on one side of the wall of rock, as if some considerable force had upheaved one side. Such a wall of unstratified rock is termed a *dyke*, and when it does not occur, and the rocks have merely slipped more on the one side of a dislocation than on the other, such slip is termed a *fault*. It is important to notice these facts, and they are never so well exhibited as in sea-cliffs, precisely, therefore, where a naval man may have good opportunities of observing them.

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[*] It should be here observed, that geologists do not confine the term rock to hard substances usually so named, but apply it also to sands, clays, marls, and any other mineral masses which compose the earth's crust. Some very hard rocks, such as limestones, contain fossils, they then can only be obtained with difficulty; but from the marls, sands, clays, and loosely aggregated sandstones, which often abound with these remains, they can readily be detached. When very tender, it is better to take up a lump of clay, marl, or sandstone, which may be full of organic remains, and keep it in some convenient part of the ship until brought home, when it may be opened carefully by those to whose charge it may be delivered.

Coral islands, more particularly those of the Pacific, have often engaged the attention of the mariner. Those which constitute circular groups are now generally considered to be the work of those creatures which make and inhabit the bodies commonly called corals, and which have established themselves on the craters of submarine volcanos; an opinion which all recent observations appear to strengthen. Researches, therefore, among these circular islands, in order to detect portions of volcanic rocks, (which are indeed reported to have been found,) are important. Probably portions of such rocks may be more frequently detected than is commonly supposed, in the beaches usually thrown up on the windward sides of such islands. It has been considered by some of the naturalists, who have accompanied expeditions to the Pacific, that corals do not by any means raise the high walls from great depths, commonly supposed, but that, on the contrary, they only build to the height of a few fathoms, and under favourable circumstances. It is also considered, that three particular genera of corals, named *Meandrina*, *Caryophyllia*, and *Astrea*, are the principal architects of these strûctures. Supposing that a naval man, who may happen to land upon any one of these islands, be desirous of ascertaining what particular kind of corals do principally form them: although no naturalist, he may still greatly aid the investigation, by looking about for differences in the various corals presented to his attention, which probably his eye will soon enable him to detect. He has now only to collect specimens of these different kinds, and to ticket them on the spot, stating the relative proportion in which any particular kind may seem to him to abound more than the others. Many rare corals are found in the still water, either in the lagoons, or in the little bays to the leeward of coral reefs, which are highly valuable to the naturalist. They should, however, be collected with great care, to prevent injury to the tops of the cells inhabited by the animals; they should then be carefully dried, and packed with tow in a box or locker. Some coral islands seem to have been elevated above the level of the sea subsequently to their formation, as for instance, Henderson's Island, observed by Captain Beechey, in the Pacific.

When in harbours naval men, possess abundant opportunities of procuring specimens of the fish, *crustacea*,* and shells of the particular country they may be in. Large specimens of fish are necessarily of difficult preservation, but smaller fish may be readily secured in bottles or jars of spirit, or even in brine, if spirit cannot be readily obtained. It is always desirable, that the spirit should be colourless, and of about the strength of rum or brandy fit for drinking. Care should be taken to plunge the fish into *fresh water* before it is placed in spirit, but not so roughly as to injure the scales or fins; a small hole should be made in the belly, to let the spirit in, and each fish separately wrapped in linen or paper, to prevent one specimen from rubbing and injuring another. The same care should be observed when packing crustacea or shells with the animals in them.

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* Animals of the crab, lobster, and shrimp kind.

When parties are sent out to haul the seine, excellent opportunities are afforded for procuring a great variety of marine productions. It is a very common practice to throw away the fish not considered good for the table. These are precisely the fish least known to naturalists; and if the seine be hauled, as is often the case, in distant parts of the world, the officers who superintend might usefully employ themselves in saving specimens of these commonly rejected fish. It rarely happens, but that a quantity of curious crabs, and creatures of the star-fish kind, with sea-eggs, and other things, comes up with the seine, more particularly in tropical countries. On such occasions, a naturalist rarely fails of reaping an excellent harvest, and therefore those who would wish to assist him, or science generally, should not suffer such opportunities to escape.

Shells are very commonly collected during voyages, and brought home; but it generally happens that they are selected for their beauty. To such an extent indeed has this practice been carried, that, after several ships have touched at particular places, an abundance of such shells have been poured into the cabinets of Europe, while an equal abundance of other shells, of inferior beauty, are unknown to naturalists, though by no means rare, at the very same places. The object of the true naturalist goes something beyond the mere possession of several handsome shells; he looks to the organic structure of the animals inhabiting and forming them, to the geographical distribution of species over the face of the globe, the kind of situation they delight to inhabit, and many other particulars, which it would be out of place to notice here. It therefore is of consequence to him to obtain every kind of shell in the actual state in which it is found, whether handsome or hideous. Even damaged shells, when none others can be obtained, are valuable, inasmuch as they enable him to determine the geographical distribution of species. As the organic structure of the animals inhabiting shells constitutes a principal branch of study, it becomes important to obtain the animals in the shells, and this naval men may frequently do; and by plunging them into spirits, they can readily preserve them for examination. If possible, when a shell is procured, information as to the kind of bottom it inhabits, the common depth at which it is usually found, and other particulars connected with it, should be obtained. A mark being placed on the specimen, if plunged into spirit, and a corresponding mark being made in a note-book, the particulars thus acquired will not be lost, and there will be no danger of confounding one shell with another.

We will not fatigue our readers by discussing this subject further. Our object will be attained, if we have shewn that naval men can greatly contribute to the advancement of general science, without at all neglecting their leading and important duties, and during many an hour that they may not be engaged in such duties, they can not only assist others, but render those times that are often tediously passed, hours of pleasure and instruction. The mere towing of a fine gauze net, during light air, and in a calm sea, will sometimes produce an abundance of curious creatures. If on a coast seldom visited, an officer, going down to his boat, collects several of the sea-weeds over which he treads,* to be subsequently dried and preserved, he does that which costs him little trouble, and yet he has the satisfaction of knowing that he is at that moment, perhaps, the means by which a hitherto unknown production is presented to the scientific world.

H. T. D. B.

V. *Hints for collecting Specimens illustrative of Zoology.*

OFFICERS in His Majesty's navy who may feel inclined to collect specimens illustrative of natural history, or to make observations on the habits of animals, have great opportunities of forwarding that branch of science.

Those who are desirous of taking advantage of such opportunities, should have with them some standard works in natural history, and books which treat of the mode of preserving animals, such as "Taxidermy," "Swainson's Naturalist's Guide," and "Bullock's." In addition to the technical information to be gained from these, they may perhaps derive some assistance from the following Hints, principally for collecting marine animals.

CORALS.

The most beautiful and luxuriant species are to be found between the tropics; but scarcely any seas, save those where an eternal frost reigns, are without these zoophytes. If carefully removed, with a sufficient portion of the stone, rock, or other surface to which the base is attached, the specimens may present not only much desirable information as to the mode of reproduction and

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* The geographical distribution of marine plants (sea-weeds) is as yet but little known, though, no doubt, in harmony with other natural productions, they are governed by some great general law. Specimens, therefore, of these, which require but little trouble in collecting, are of importance. They can readily be dried between blotting paper.